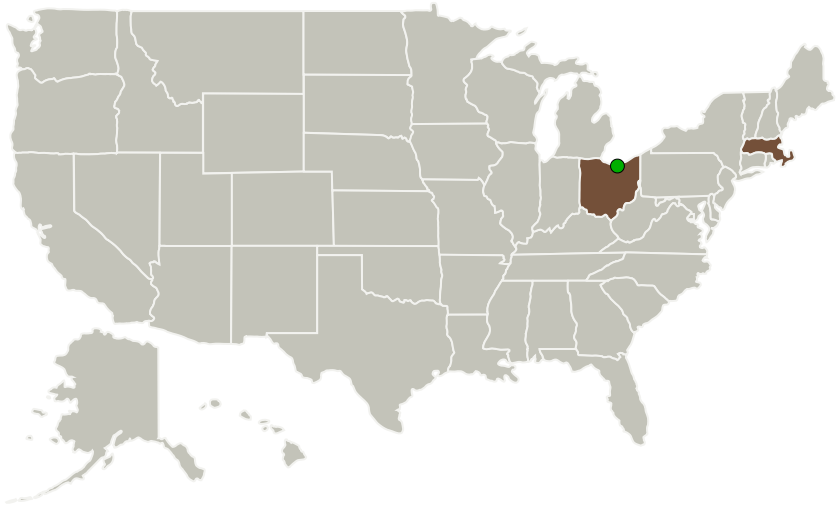
High Input Voltage Hall Thruster Discharge Converter, Phase I

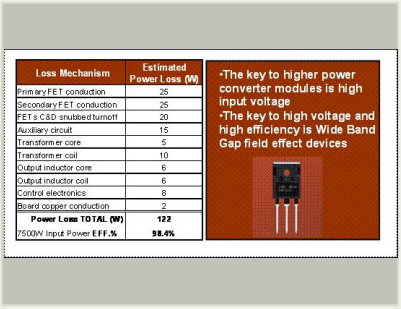
Completed Technology Project (2013 - 2013)

Project Introduction

The overall scope of this Phase I/II effort is the development of a high efficiency 15kW (nominal) Hall thruster discharge converter. In Phase I, Busek Co. Inc. will design, fabricate and test a nominal 7.5kW breadboard discharge converter module. Busek proposes a converter topolgy called the Leading Edge Auxiliary Phase Shifted (LEAPS) Bridge, which is a modification of the standard phase shifted bridge that uses an energy-recovering auxiliary circuit to force the transition from output inductor freewheel to power flowing through the main transformer. Based on preliminary measurements with this topology the converter module demonstrated >97% efficiency at reduced power. A 300V line input and 300-400V output range are the benchmark for the discharge converter in Phase 1. The most reasonable path with higher input voltage for higher power converters involves the use Wide Band Gap FETs. MOSFETS represent the greatest payoff in terms of efficiency improvements and are a primary focus for a discharge converter to achieve an efficiency of 98% or greater. With the design maturity gained from the Phase I breadboard, the Phase II objective will be the production of a 15kW brassboard PPU in a flight-like form factor that incorporates conductive cooling.

Primary U.S. Work Locations and Key Partners





Loss Mechanism	Estimated Power Loss (W)
Primary FET conduction	25
Secondary FET conduction	25
FETs C&D snubbed turnoff	20
Auxiliary circuit	15
Transformer core	5
Transformer coil	10
Output inductor core	6
Output inductor coil	6
Control electronics	8
Board copper conduction	2
Power Loss TOTAL (W)	**122**
7500W Input Power **EFF.%**	**98.4%**

•The key to higher power converter modules is high input voltage
•The key to high voltage and high efficiency is Wide Band Gap field effect devices

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Table of Contents

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Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Massachusetts	Ohio

Project Transitions

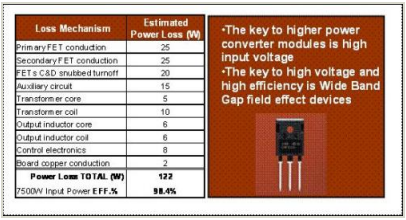
May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138204)*

Images



Project Image
High Input Voltage Hall Thruster Discharge Converter
(https://techport.nasa.gov/image/128057)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Busek Company, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

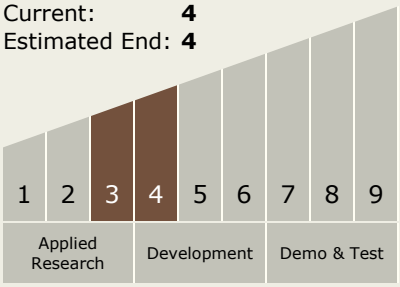
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Thomas Jaquish

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System